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May 27, 2005

PG&E Letter DCL-05-067

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Docket No. 50-275, OL-DPR-80
Diablo Canyon Unit 1
Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors

Dear Commissioners and Staff:

On February 11, 2003, the NRC issued Order EA-03-009 for interim inspection requirements for reactor pressure vessel (RPV) heads at pressurized water reactor (PWR) facilities. On February 20, 2004, the NRC issued the First Revised Order EA-03-009, which superseded Order EA-03-009. Revision 1 of the Order modified the requirements regarding nondestructive examination of the penetration nozzles.

Pacific Gas and Electric Company (PG&E) provided responses consenting to the Order and Revision 1 of the Order in PG&E Letter DCL-03-022, "Twenty-Day Response to NRC Order Modifying Licenses (EA-03-009)," dated February 28, 2003, and PG&E Letter DCL-04-021, "Twenty-Day Response to First Revision of NRC Order Modifying Licenses (EA-03-009)," dated March 11, 2004, respectively.

PG&E anticipates that it may need relaxation from the requirements for nondestructive examination of the penetration nozzles below the J-groove weld for which PG&E cannot obtain coverage as specified in the Order. Pursuant to the procedure specified in Section IV, paragraph F, of Revision 1 of the Order, PG&E requests relaxation from the requirements specified in Section IV, Paragraph C.(5)(b)(i) for Unit 1 of the Diablo Canyon Power Plant (DCPP) for the RPV head penetration nozzles for which ultrasonic testing requirements cannot be completed as required. The need for relaxation will be confirmed during the DCPP Unit 1 refueling outage thirteen (1R13).

The NRC approved relaxation from the Order for Unit 2 by letter, "Diablo Canyon Power Plant, Unit No. 2 – Relaxation of Requirements Associated With First Revised Order (EA-03-009) Regarding Alternate Examination Coverage for

A101

Reactor Pressure Vessel Head Penetration Nozzles (TAC No. MC4932)," dated November 23, 2004.

Enclosure 1 of this letter provides the Unit 1 relaxation request. As demonstrated in Enclosure 1, the requested relaxation meets item IV.F.(2) of Revision 1 of the Order, as compliance with the Order for the specific areas described in the request would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

PG&E previously provided a proprietary and non proprietary copy of WCAP-15429, Revision 0, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Diablo Canyon Units 1 and 2," in PG&E Letter DCL-04-146, "Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors." Westinghouse has provided PG&E with flaw propagation graphs for two additional nozzle angles (30.2 degrees and 38.6 degrees). The graphs are included in Enclosure 1 as Figures 9 and 10.

The scheduled start date for 1R13 is October 24, 2005. The reactor head penetration volumetric examination is currently scheduled to be completed by November 8, 2005. In order to support the schedule for reactor head examinations, PG&E requests approval of this relaxation request by that date. PG&E will provide the results of the examination as the data is acquired, which will define the scope of the relaxation needed.

If you have any questions or require additional information, please contact Stan Ketelsen at (805) 545-4720.

Sincerely,

DJacobs

Donna Jacobs
Vice President Nuclear Services

mjr/4557
Enclosures

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	Terry W. Jackson
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RELAXATION REQUEST FROM NRC FIRST REVISED ORDER EA-03-009 SECTION IV, Paragraph C.(5)(b)(i)

Diablo Canyon Power Plant (DCPP) Unit 1

1. System/Component for Which Relaxation is Requested

The scope of this relaxation includes the 79 DCPP Unit 1 ASME Class 1 reactor pressure vessel (RPV) head penetrations as delineated in Table 1. The DCPP Unit 1 Order Inspection Category, in accordance with Section IV, Paragraph A, is determined to be "moderate," based on an approximate 11.2 effective degradation years (EDY) at the beginning of the Unit 1 thirteenth refueling outage (1R13).

Table 1 - Number and Type of Penetrations

Penetration Description	Number
Control Rod Drive Mechanism - full length	53
Control Rod Drive Mechanism - part length	8
Head Vent	1*
Spare Control Rod Drive Mechanism	12
Instrument Column	6
Total Penetrations	**80***

* Inspection coverage limitations are not anticipated for the head vent, so it is not included in scope of this submittal.

Combustion Engineering drawing 232-452, "Control Rod Penetration Details," shows the head configuration and Combustion Engineering drawing 232-451, "Contol Rod Mechanism Housing Details," shows the nozzle design including the tapered and threaded portion at the bottom of the nozzle.

2. Applicable Examination Requirements

The NRC issued Revision 1 of Order EA-03-009 (hereafter referred to as the Order), on February 20, 2004, establishing interim inspection requirements for RPV heads of pressurized water reactors. Section IV, Paragraph C (Parts 1, 2, 3, and 4), require nonvisual nondestructive examination (NDE) in accordance with Section IV, Paragraph C.(5)(b). Section IV.C.(5)(b) of the Order states the following:

(b) For each penetration, perform a nonvisual NDE in accordance with either (i), (ii), or (iii):

(i) *Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-1]); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-2). In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.*

(ii) *Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-3]); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-4).*

(iii) *A combination of (i) and (ii) to cover equivalent volumes, surfaces and leak paths of the RPV head penetration nozzle base material and J-groove weld as described in (i) and (ii). Substitution of a portion of a volumetric exam on a nozzle with a surface examination may be performed with the following requirements:*

1. *On nozzle material below the J-groove weld, both the outside diameter and inside diameter surfaces of the nozzle must be examined.*

2. *On nozzle material above the J-groove weld, surface examination of the inside diameter surface of the nozzle is permitted provided a surface examination of the J-groove weld is also performed.*

3. Requirement from Which Relaxation is Requested

Relaxation is requested from Section IV.C.(5)(b)(i) of the Order to perform ultrasonic testing (UT) of the RPV head penetrations inside the tube from 2 inches above the J-groove weld to:

- 2 inches below the lowest point of the toe of the J-groove weld (or the bottom of the nozzle if less than 2 inches) OR
- 1.0-inch below the lowest point of the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension and greater.

Specifically, the relaxation requested is that the UT examination distance be changed to 2 inches above the J-groove weld down to the lowest elevation that can be practically inspected on each nozzle with the UT probe being used. It is PG&E's intent to perform the UT examination to the maximum extent possible.

4. Reason for Request

Pacific Gas and Electric Company (PG&E) is requesting relaxation of the requirements specified in Section IV.C.(5)(b)(i) for DCPP Unit 1 for the RPV head penetration nozzles for which ultrasonic testing requirements cannot be completed as required. Pursuant to the Revision 1 of Order EA-03-009, Section IV.F.(2), compliance with the Order for specific nozzles would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the ultrasonic probes used at DCPP, it is expected that we will not be able to complete the full extent of ultrasonic testing from 2 inches above the J-groove weld to 2 inches below the lowest point of the toe of the J-groove weld, the bottom of the nozzle, or 1.0-inch below the lowest point at the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension and greater for some of the RPV head penetration nozzles.

Ultrasonic probes used to detect circumferential flaws are not effective near the end of the nozzle. These probes have separate transducers arranged vertically for sending and receiving the ultrasonic signal. The transducers in the probe are approximately one inch apart. With this configuration, the lower transducer will not contact the inside wall of the nozzle unless the upper transducer is inserted greater than approximately 1.0-inch into the nozzle. Since the scanning process requires that both transducers be in contact with the surface, the probe cannot scan the lower end of the nozzle. The Open Housing Probe has transducers oriented both vertically and horizontally, which will reduce the extent of inaccessible examination areas. Figures 1 and 2 show the configuration of the UT probes in relation to the nozzles.

Figure 1
Trinity Probe

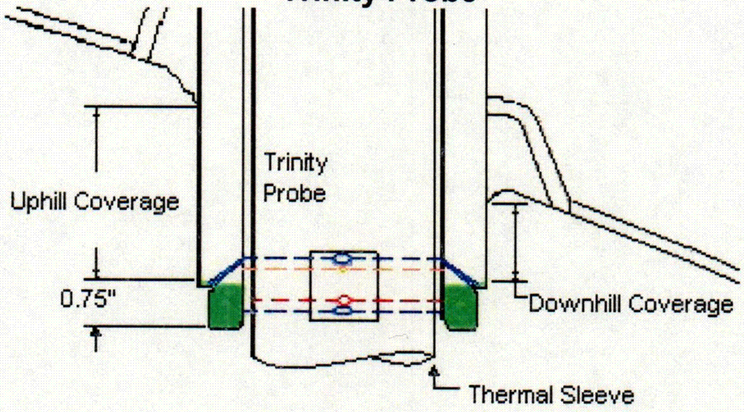
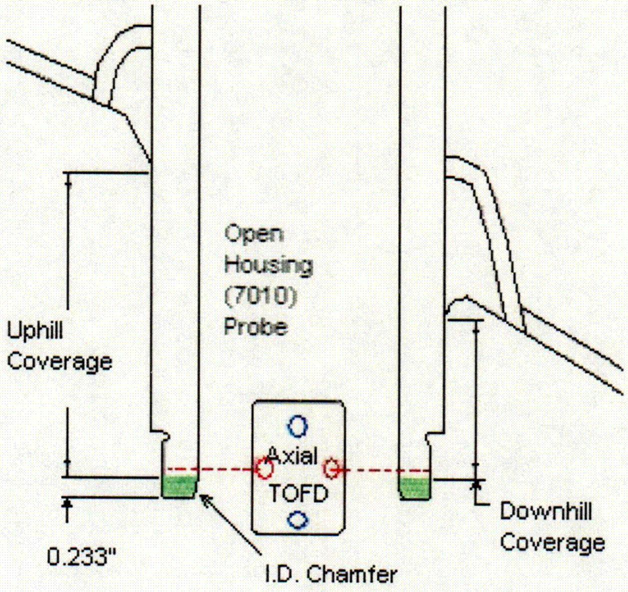


Figure 2
Open Housing Probe
(Circumferential beam direction)



C01

Inspection details:

The penetration nozzles installed in the Diablo Canyon Unit 1 RPV head have a 15-degree chamfer that extends up 0.233 inches into the inside diameter (ID) of the tube. There is also a threaded area with a thread relief on the outer diameter of the tube that extends up 0.75 inches from the bottom. These geometries limit the coverage for both of the UT inspection tools that will be used on the Unit 1 RPV head penetrations. When the lower transducer on the probes goes below the top of the ID chamfer, the probes lose contact with the ID surface and it is not possible to obtain data.

Based on the geometry involved in the transducer location and the chamfer at the lower end of the nozzle, the portion that cannot be scanned is the portion extending from the bottom of the nozzle upward for a distance of approximately 1.0 inch.

Westinghouse will use two probes to perform UT inspection of the penetration nozzles at DCPP Unit 1. The Trinity Probe will be used to inspect nozzles that contain thermal sleeves (53 total) and part-length control rod drive mechanism (CRDM) drive shafts (8 total). The Open Housing Probe will be used to inspect nozzles without thermal sleeves (18 total). Both probes use axially oriented time-of-flight tip diffraction (TOFD) as the primary crack detection method. The vent line examination (1 total) is not included in the discussion as this examination area has a different geometry that is not limited.

The TOFD technique uses two transducers (a transmitter and a receiver) oriented along the vertical axis of the probe. The focus point of the TOFD beam is at the midpoint between the upper and lower transducers. Credit is only taken for inspecting areas that are covered by the focus point.

The Open Housing Probe has a transducer pair with a 55 degree angle of refraction. The Trinity Probe has a transducer pair with a 44 degree angle of refraction. Since the Trinity Probe transducers are a smaller size and spacing is less than that of the Open Housing Probe, the focus point of the Trinity Probe transducers are at a lower elevation (closer to the bottom of the tube) than the Open Housing Probe focus point when the probes reach the top of the ID chamfer. However, due to the difference in the refracted angles, the thread relief on the OD of the tube interferes with the TOFD beam for the Trinity Probe. Due to this interference, there is a small area above the thread relief where the Trinity Probe cannot inspect. Figure 3 shows the lower transducer at the top of the ID chamfer and the OD thread relief interference with the TOFD beam. Figure 4 shows the probe at the minimum (higher) elevation where the TOFD beam is not interrupted by the thread relief.

The hashed areas from both Figures 3 and 4 make up the total portion of the tube that cannot be inspected. The dimensions listed in Table 2 are based on the maximum coverage limitation of 0.851 inches shown in Figure 4.

Figure 3
Trinity Probe – Lower TOFD Transducer at Top of Chamfer

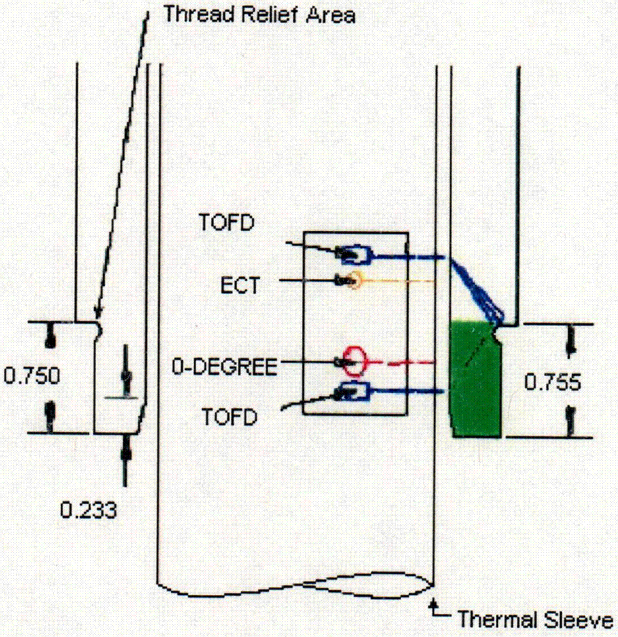
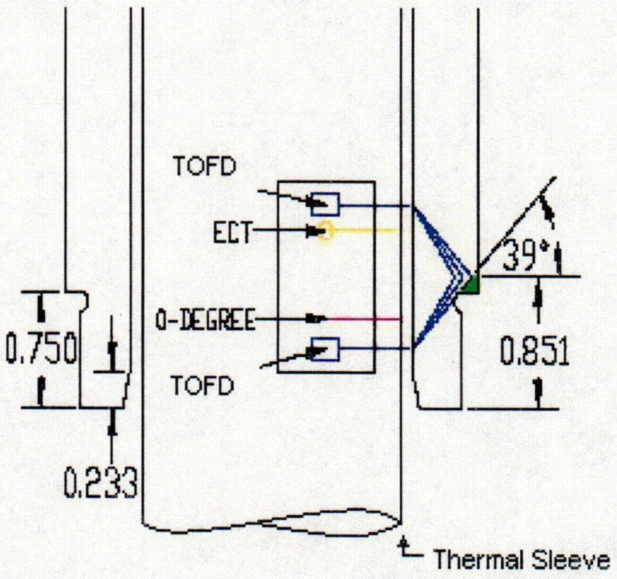


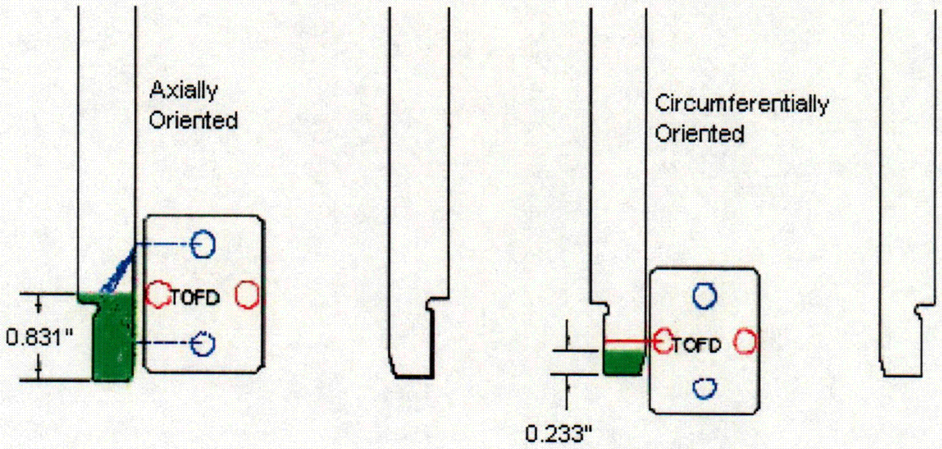
Figure 4
Trinity Probe – TOFD Beam Uninterrupted by Thread Relief

CO2



In addition to the axially oriented TOFD transducers, the Open Housing Probe has circumferentially oriented TOFD transducers that the Trinity Probe does not have. This circumferentially oriented TOFD signal allows the Open Housing Probe to inspect the tube down to the top of the ID chamfer. Also, with the Open Housing Probe's circumferentially-oriented transducers, the TOFD beam is not interrupted by the OD thread relief. The dimensions listed in Table 2 reflect the circumferential TOFD transducer coverage limitation of 0.233 inches. This is why the Open Housing Probe coverage is consistently greater than the Trinity Probe coverage. Figure 5 shows both the axial and circumferential Open Housing Probe TOFD coverage limitations. The hashed areas indicate the portions of the tube that cannot be inspected.

Figure 5
Open Housing Probe Coverage Limitations



C03

Table 2 shows the penetrations that will be inspected and their respective angle grouping. Industry field experience, including the examination of DCPP Unit 2, has shown that the J-groove weld reinforcement is larger than shown on design drawings. Therefore, actual scan coverage will be determined from the field data taken during the 1R13 inspection and that data will establish the limits to be used in the relaxation request. The accuracy of this measurement will be plus or minus 0.04 inches, based on the device data sampling capabilities. The specific limits to be used in the relaxation request will be provided to the NRC in a supplement to this request.

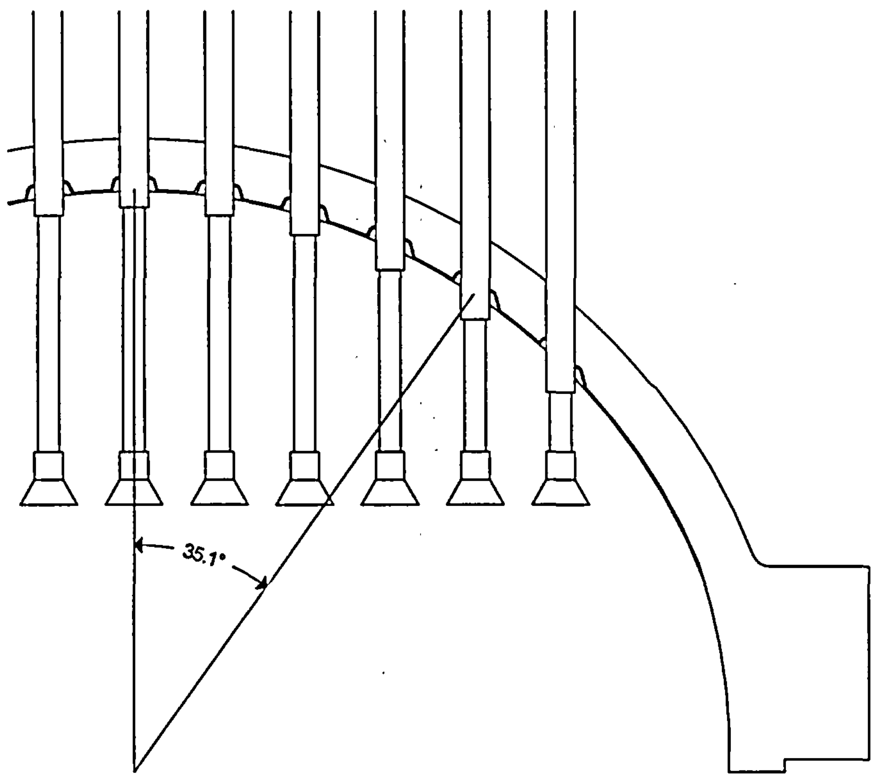
The penetrations are grouped in Table 2 according to penetration angle as measured from the center of the head. These dimensions are described by the penetration head angle noted in Table 2 and depicted in Figure 6. The penetration head angle is measured from the centerline of the reactor head to the intersection of the inner radius of the head with the center of each penetration tube as depicted in Figure 6. The 20 ksi stress level line in 4 selected tubes, as determined in WCAP-15429-P, Revision 0, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Diablo Canyon Units 1 and 2," dated February 2005 is also noted in Table 2. PG&E previously provided a proprietary and non proprietary copy of WCAP-15429, Revision 0, in PG&E Letter DCL-04-146, "Relaxation Request for NRC Issuance of First Revised Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors." Westinghouse has provided PG&E with flaw propagation graphs for two additional nozzle angles (30.2 degrees and 38.6 degrees). The graphs are included in Enclosure 1 as Figures 9 and 10. Revision 1 also investigates the impact of a larger fillet weld size in the as-built J-weld configuration for Unit 2 CRDM penetration Nos. 35 and 55. A short discussion of the results is provided in Section 5 of Enclosure 1; subsection "Stress Distribution Graphs."

Table 2 – Penetration Data

Penetration Number	Angle (Degrees)	20 KSI line*				Inspection Method
		Uphill Side		Downhill Side		
		ID	OD	ID	OD	
1	0	.85	.35	.85	.35	Trinity Probe
2-5	8					OH Probe
6-9	11.4					Trinity Probe
10-13	16.2					Trinity Probe
14, 16, 18, 20	18.2					Trinity Probe
15, 17, 19, 21	18.2					OH Probe
22-25	23.3					Trinity Probe
26-29	24.8					OH Probe
30-37	26.2	1.35	.45	.49	.35	Trinity Probe
38-45	30.2					Trinity Probe
46-49	33.9					Trinity Probe
50-57	35.1					Trinity Probe
58-61	36.3					Trinity Probe
62-69	38.6					Trinity Probe
70-73	44.3	2.4	.30	.19	.32	Trinity Probe
74-79	48.7	2.7	.25	.15	.35	OH Probe

* 20 KSI line data interpolated from stress distribution plots in WCAP-15429.

Figure 6
Penetration Angle (typical)



The Order allows for performing eddy current testing or dye penetrant testing (Section IV, Paragraph C.(5)(b)(ii)), in lieu of ultrasonic testing.

The bottom of each nozzle terminates in a chamfered surface approximately two inches below downhill side of the J-groove weld. Eddy current probes integral to the Trinity and Open Housing Probes are used to examine the accessible surface of the ID of the tube down to the point where the eddy current probes lose contact due to the chamfered surface. The eddy current probes do not maintain adequate contact with the nozzle at its lower end due to this nozzle geometry. Using the Trinity Probe for thermal sleeved locations and the Open Housing Probe for non thermal sleeved locations, ID coverage is down to the top of the chamfered area. For both probes, the examination is capable of detecting flaws initiating on the ID surface within its scanning area.

The Order allows for dye penetrant testing. However, dye penetrant testing would require extensive work under and around the RPV head. The radiation levels under the Unit 1 head are anticipated to be between 4000 mR/hour and 9000 mR/hour. The threaded tube OD makes a dye penetrant examination on the lower section of the tube impractical, resulting in the section of tube inaccessible to UT testing being not available for dye penetrant testing. Therefore, performing dye penetrant testing on the bottom nozzle area would result in significant radiation exposure to personnel without a compensating increase in the level of quality or safety.

Accordingly, pursuant to Section IV.F.(2) of the Order, PG&E is requesting a reduction of the examination coverage area based on a flaw-tolerance analysis approach. As discussed below, this approach will provide an acceptable level of quality and safety with respect to the reactor vessel structural and leakage integrity.

5. Proposed Alternative and Basis for Use

It is PG&E's intent to perform the UT examination to the maximum extent possible. However, PG&E proposes to utilize the inspection option (b)(i) and will achieve UT coverage two inches above the J-groove weld down to the lowest elevation that can be practically inspected on each nozzle with the UT probe being used.

Testing of portions of the nozzle significantly below the J-groove weld is not significant to the phenomena of concern. The phenomena that are of concern are leakage through the J-groove weld and circumferential cracking in the nozzle above the J-groove weld. This is appropriately reflected in the requirement (as stated in Section 3 above) that the testing extend to two inches above the J-groove weld. However, the Order also requires that testing be extended to:

- 2 inches below the lowest point of the toe of the J-groove weld (or the bottom of the nozzle if less than 2 inches) OR
- 1.0-inch below the lowest point at the toe of the J-groove weld and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level of 20 ksi tension or greater.

The nozzle is essentially an open-ended tube, and the nozzle wall below the J-groove weld is not part of the reactor coolant system (RCS) pressure boundary.

PG&E anticipates not being able to completely comply with the requirements for UT inspection of the four-inch-diameter penetration nozzles (used for CRDMs, thermocouples, spares, etc.) below the J-groove weld, due to the physical configuration of the nozzles and the limitations of the test equipment. The bottom ends of these nozzles are externally threaded and internally tapered. Loss of UT probe coupling due to the internal taper and/or disruption of the UT signal due to the external thread will prevent UT data acquisition in a zone extending to approximately one inch above the bottom of each nozzle.

PG&E believes the proposed inspection coverage is adequate because the cited inspection limitation for the four-inch-diameter nozzles does not preclude full UT examination coverage of the portions of these nozzles that are of primary interest.

This is because:

- UT of the most highly stressed portion of the nozzle (the weld heat affected zone) is unaffected by this limitation.
- UT of the interference fit zone above the weld (for leakage assessment) is unaffected by this limitation, and cracks initiating in the unexamined bottom portion (non pressure boundary) of the nozzle would be of minimal safety significance with respect to pressure boundary leakage or nozzle ejection, since this portion of the nozzle is below the pressure boundary and any cracks would have to grow through a significant examined portion of the tube to reach the pressure boundary.

This proposal is consistent with the analysis submitted in the industry topical report MRP-95 and the site-specific analysis in WCAP-15429-P, Revision 0, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Diablo Canyon Units 1 and 2," dated February 2005. The zones of inspection selected are such that the stresses in the remaining uninspected zones are at levels for which primary stress corrosion cracking is considered highly unlikely.

The major inherent conservatisms in WCAP-15429-P, Revision 0, are summarized below:

Conservatism in Assumed Crack Geometry:

There is nearly universal agreement that high stresses, on the order of the material yield strength, are necessary to initiate Primary Water Stress Corrosion Cracking (PWSCC). There is no known case of stress corrosion cracking of Alloy 600 below the yield stress. The yield strengths for wrought Alloy 600 head penetration nozzles are in the range of 37 ksi to 65 ksi. Weld metal yield strengths are generally higher. The yield strength of the head penetration nozzles for DCPP Unit 1 varies from 35 ksi to 45 ksi, which is a room temperature value obtained using a 0.2 percent offset. The stress level of 20 ksi is a conservative value below which PWSCC initiation is extremely unlikely.

Therefore, the assumption of any PWSCC crack initiation in the region of the penetration nozzle with a stress level of 20 ksi or less is conservative. The assumption of a through-wall flaw in these unlikely PWSCC crack initiation regions of the head penetration is an important additional conservatism, since the penetration tubes will be inspected with maximum achievable coverage on the tube ID.

Conservatism in Recommended PWSCC Crack Growth Rate:

From Table 5-3 of MRP-55, Revision 1, the mean crack growth amplitude (a) for typical Huntington Alloy 600 heats is summarized below:

Heat	Material Supplier	Mean a (SI units)
NX8101	Huntington	1.37x10-12
NX8664	Huntington	1.29x10-12
NX6420G	Huntington	7.21x10-13
NX9240	Huntington	4.97x10-13
NX8168G	Huntington	1.93x10-13

Huntington is the material supplier for the head penetrations for DCPP Unit 1. Since the recommended crack growth amplitude (a) from the NRC flaw evaluation guidelines is 2.67x10-12 in SI units, the recommended PWSCC crack growth rate is about a factor of 1.9 higher than that obtained from the test data for any of the Huntington material heats.

Flaw Propagation Calculations:

A structural integrity evaluation has been performed for the DCPP Unit 1 and Unit 2 reactor vessel head penetrations. A series of crack growth calculations were performed presuming a flaw where the lower extremity of this initial through wall flaw is conservatively postulated to be located on the penetration nozzle where either the inside or outside surface hoop stress drops below 0 Ksi. The calculation demonstrated that more than one operating cycle would elapse before a postulated flaw in the unexamined area of the penetration nozzle would propagate into the pressure boundary formed by the J-groove weld. An operating cycle for DCPP Unit 1 is approximately 20 months (1.67 calendar years or 1.26 Effective Full Power Years (EFPY). DCPP Unit 1 Cycle 14 is planned to be a 17-month cycle; therefore, the calculations are conservative with respect to the time until a follow-up inspection will be performed. DCPP Unit 1 is currently in the moderate susceptibility category, and is required to perform nonvisual NDE in 1R13. DCPP Unit 1 is expected to be in the high susceptibility category beginning in Unit 1 refueling outage fourteen, and therefore nonvisual NDE will be performed during each refueling outage, until the reactor head is replaced.

The methodology and the technical basis of the crack growth calculation, which was based on the hoop stress distribution and the PWSCC crack growth rate recommended in MRP-55 Revision 1, are provided in WCAP-15429-P.

Figures 7 through 12 provide results of the calculation applicable to Unit 1. The calculation demonstrates that the minimum time for a flaw to propagate from 0.3 inches below the weld to the bottom of the J-groove weld would be at least

1.8 EFPY, which is greater than one operating cycle. The results of the flaw propagation calculation indicate that, even if a flaw were to occur in the region of the penetration nozzle not being inspected, there would be adequate opportunity for detection prior to the crack reaching the RCS pressure boundary. The results demonstrate that the extent of the proposed inspection coverage would provide reasonable assurance of the structural integrity of the Unit 1 RPV head penetration nozzles and the J-groove welds. The initial flaw lengths used in the calculation for Figures 7 through 12 are provided in Table 3. The flaw propagation calculation will be verified to be applicable to the as-built weld dimensions, flaw locations and flaw sizes as measured during the DCPP 1R13 RPV head examination.

Table 3 – Initial Flaw Length used in Calculation for Figures 7 through 12

Nozzle Angle	WCAP-15429-P	Initial Flaw Length
0°	Figure 6-12	0.29
26.2°	Figure 6-13	0.40
30.2°	new	0.72
38.6°	new	0.43
44.3°	Figure 6-14	0.29
48.7°	Figure 6-16	0.20

Figure 7
Through-Wall Axial Flaws Located in the 0.0 Degrees CRDM Row of Penetrations, Downhill Side – Crack Growth Predictions for DCPP Units 1 and 2

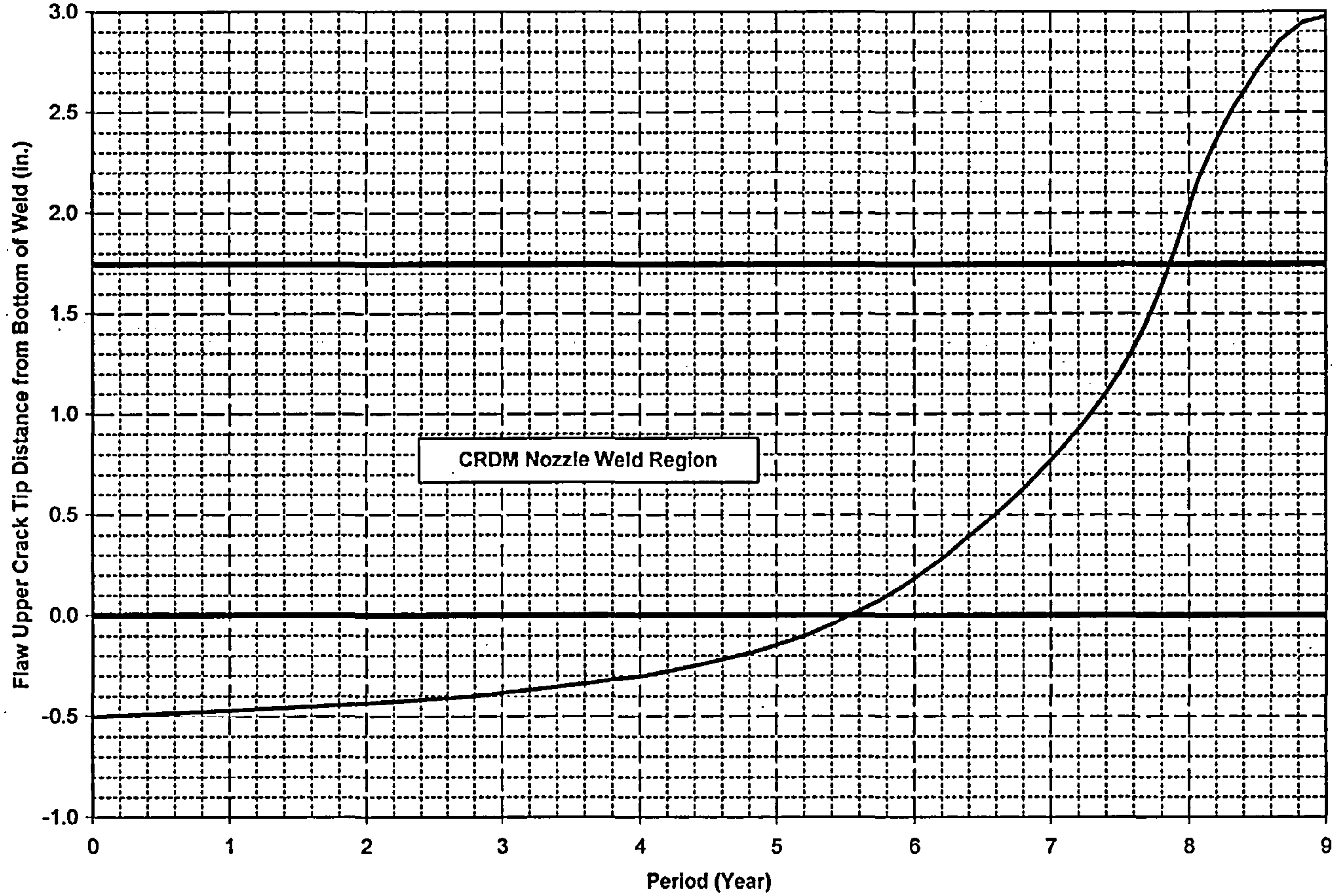


Figure 8
Through-Wall Axial Flaws Located in the 26.2 Degrees CRDM Row of Penetrations, Downhill Side – Crack Growth Predictions for DCPP Units 1 and 2

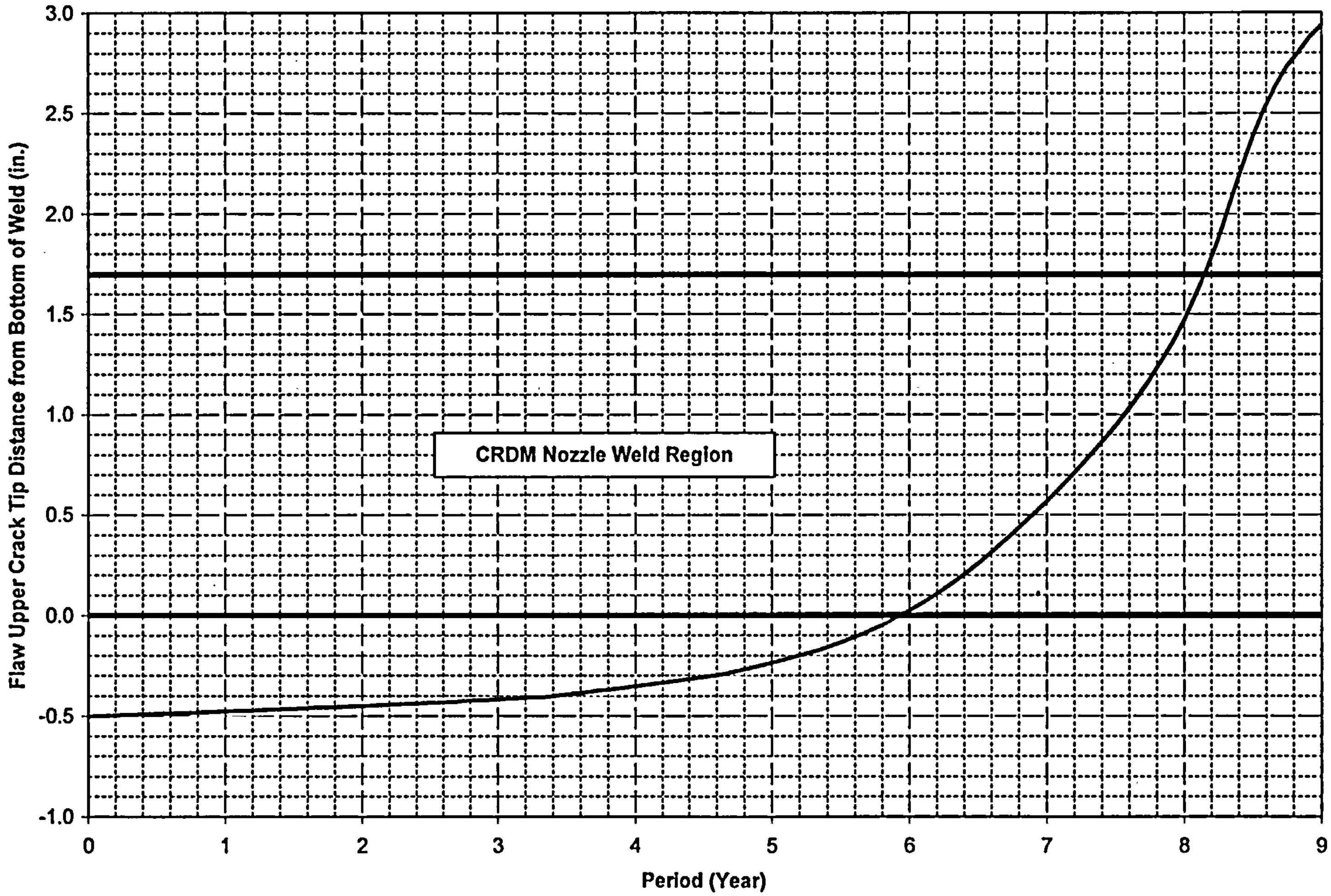


Figure 9
Through-Wall Axial Flaws Located in the 30.2 Degrees CRDM Row of Penetrations, Downhill Side – Crack Growth Predictions for DCPP Units 1 and 2

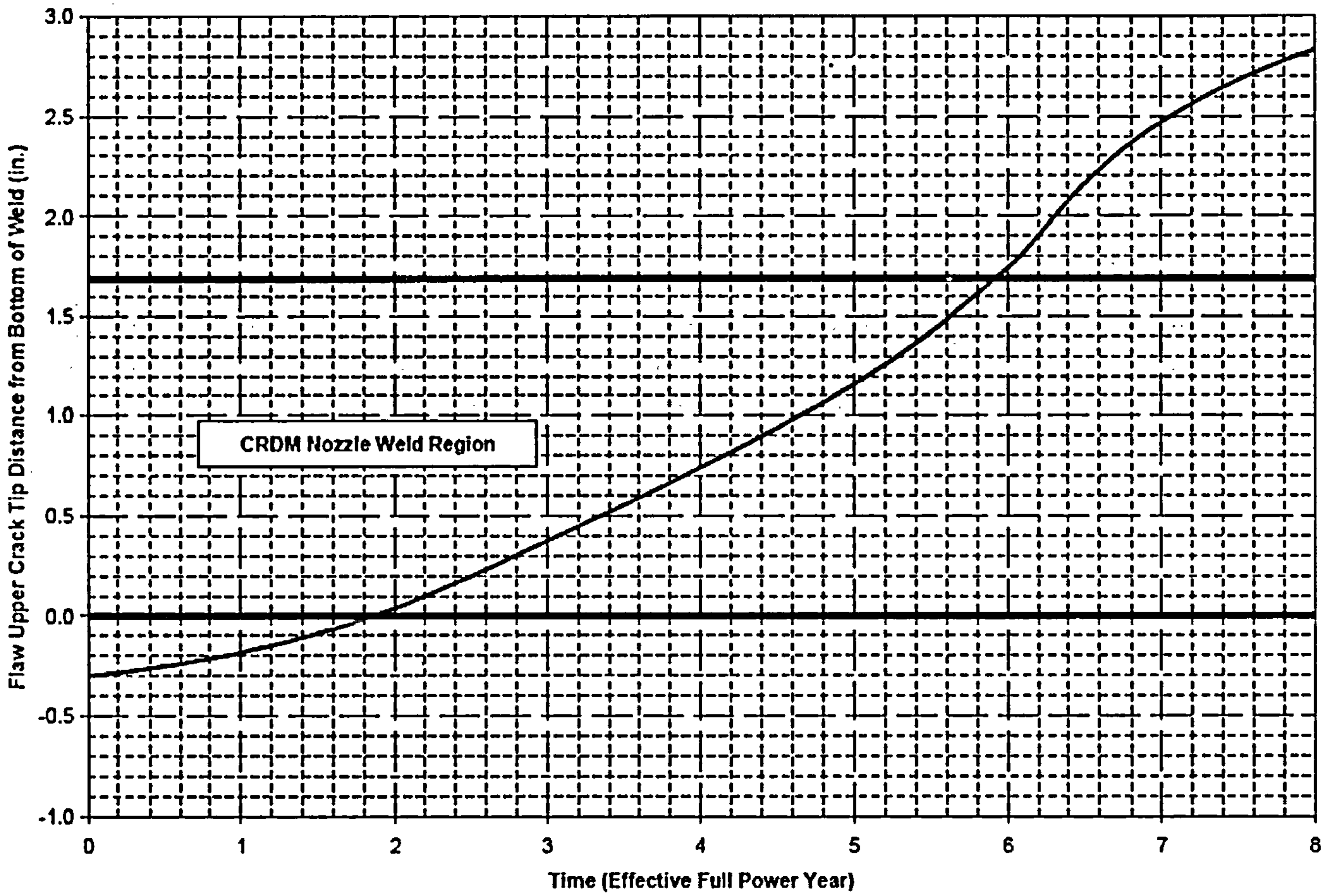


Figure 10
Through-Wall Axial Flaws Located in the 38.6 Degrees CRDM Row of Penetrations, Downhill Side – Crack Growth Predictions for DCPP Units 1 and 2

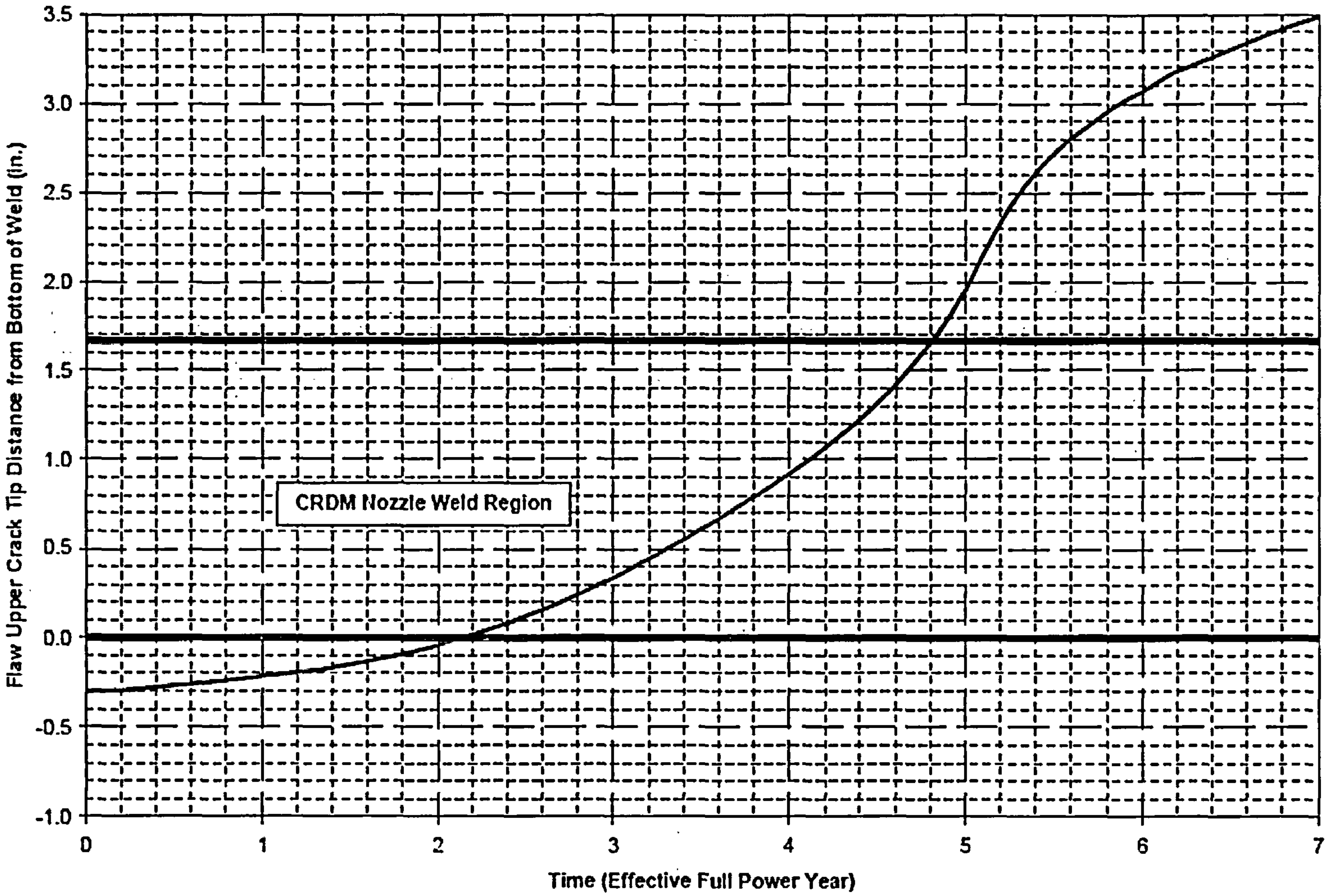


Figure 11
Through-Wall Axial Flaws Located in the 44.3 Degrees CRDM Row of Penetrations, Downhill Side – Crack Growth Predictions for DCPP Units 1 and 2

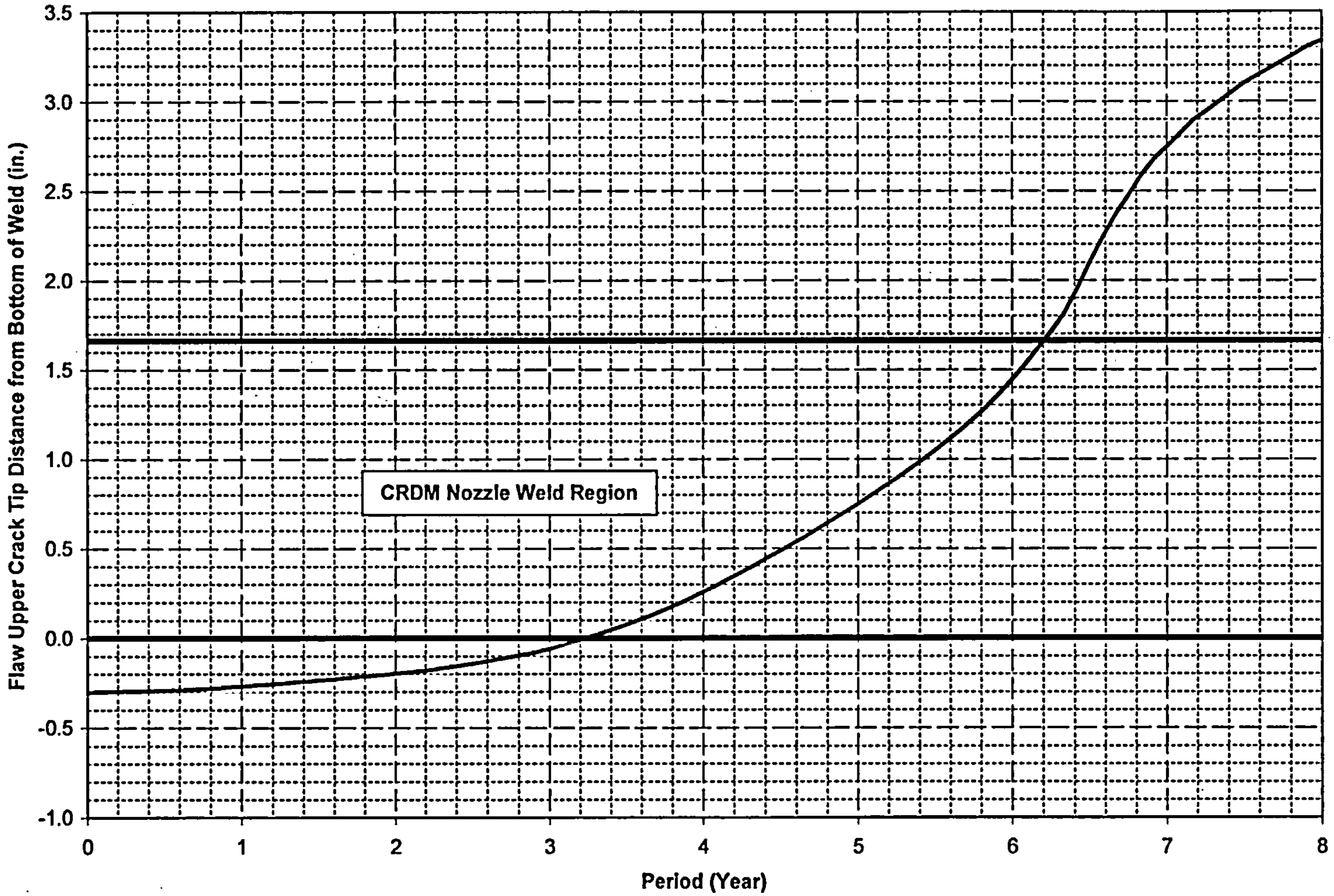
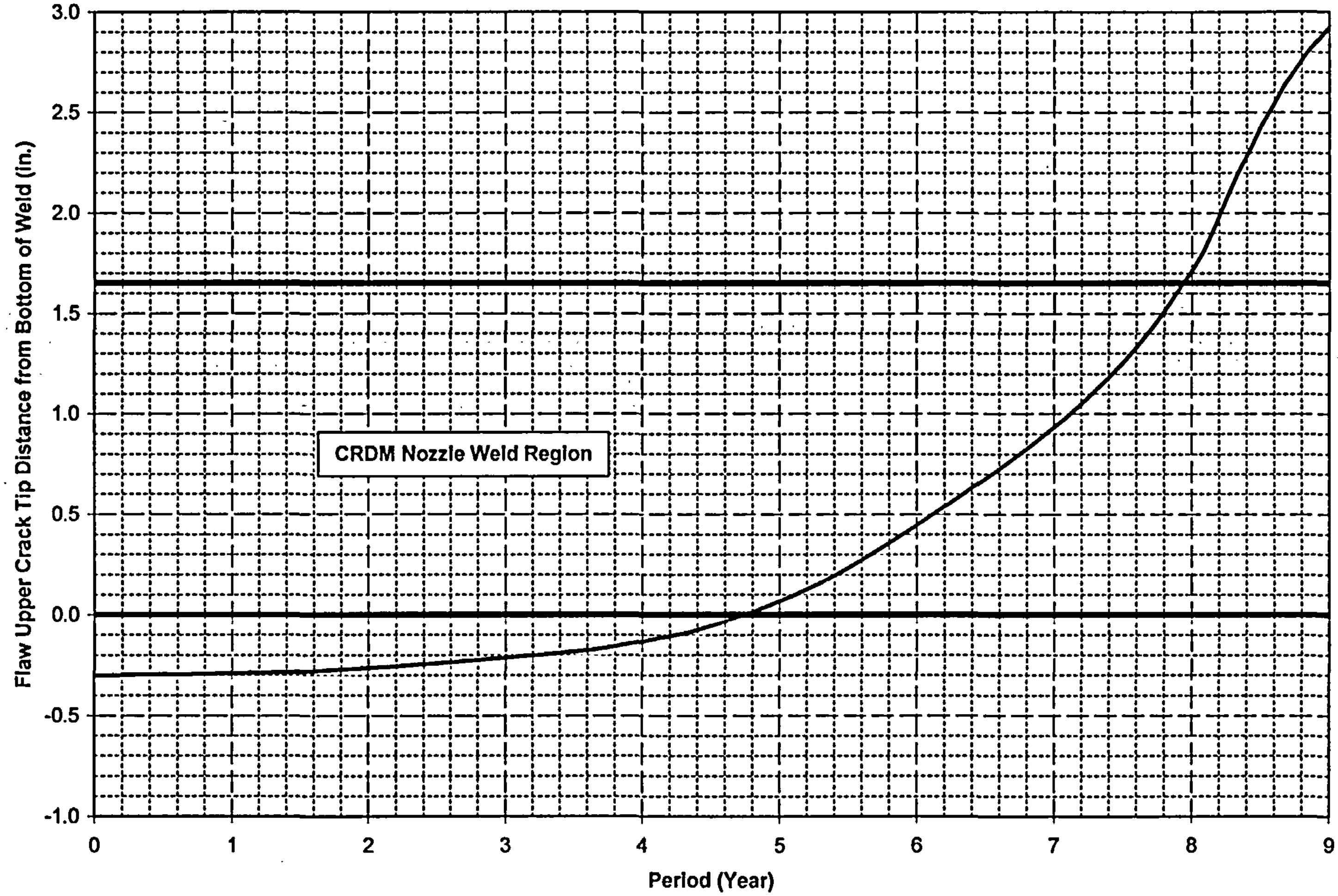


Figure 12
Through-Wall Axial Flaws Located in the 48.7 Degrees CRDM Row of Penetrations, Downhill Side – Crack Growth Predictions for DCPP Units 1 and 2



Axial Crack Stability:

As confirmation that the inspection zone defined above provides an acceptable level of safety, flaw tolerance analyses were run using the DCPP Unit 1 and 2 structural integrity evaluation, WCAP-15429-P, Section 6, for the 0, 26.2, 44.3, 45.4, and 48.7 degree penetrations. This demonstrated that flaws that could be missed because they are just outside the inspection zone would not grow to unacceptable sizes during one fuel cycle of plant operation.

With through-wall axial flaws assumed to exist in the penetration terminating at 0.5 inches below the weld for the downhill side with an aspect ratio (flaw length to flaw depth) of 6 to 1, no cracks would violate the weld in the 20-month operating cycle.

Stress Distribution Graphs:

Figures 13 through 21 are graphs of the inside and outside surface hoop stress distribution from the top of the J-weld to the bottom of the head penetration nozzles. Graphs are provided for the uphill side and the downhill side of the head penetrations for five nozzle angles. There are a total of 15 nozzle angles for the head penetrations at DCPP Unit 1. Selected rows of penetrations and the center penetration were analyzed to provide additional results so that a trend can be established as a function of radial location. The penetration nozzle angles selected for this analysis consist of the center penetration (0 degrees), the outermost penetration (45.4 and 48.7 degrees), and two angles in between the center and the outermost penetrations (26.2 and 44.3 degrees)[1].

In order to evaluate the Unit 2 refueling outage twelve penetration inspection coverage, additional evaluations were performed by Westinghouse based on the actual weld size, rather than the design weld dimension. Based on the actual weld sizes, the stress profiles below the weld decrease significantly, and therefore the time for a flaw to grow to the weld increases significantly. These results are also applicable to Unit 1. Therefore it is expected that the actual UT coverage achieved in Unit 1 will be adequate to demonstrate that a flaw below the coverage area would take significantly longer than a fuel cycle to grow from the uninspected area to the toe of the J-groove weld.

Previous examination history:

The DCPP 1R13 inspection in November 2005 will be the first Unit 1 under-the-head volumetric inspection. Therefore, there are no previous photographs showing how far the penetrations protrude below the head. The previous DCPP Unit 1 head examination was a bare metal visual examination performed in

[1] Figures 18 and 19 are only applicable to Unit 2 and are included here for information only. Unit 1 does not have any 45.4-degree penetrations.

March 2004 during 1R12. The examination did not find any evidence of boric acid deposits on the surface of the reactor head.

Penetration tube materials:

The heat numbers and detailed material composition for DCPP Unit 1 are contained in Table 4-1 of WCAP-15429-P.

6. Justification for Granting of Relaxation

The proposed inspection will ensure that there are no concerns with the structural integrity of the DCPP Unit 1 RPV penetration nozzles that could be caused by cracking in the Order coverage areas that are not examined.

This conclusion is based on the following:

- UT inspection will be performed for the higher stressed areas of all DCPP Unit 1 head instrument and nozzle penetrations.
- The combination of leak path ultrasonic examination and visual inspection will provide assurance that no leaks exist that could cause OD initiated circumferential cracking above the weld.
- PG&E will verify, using the flaw-tolerance analyses that were run using the DCPP Unit 1 and 2 structural integrity evaluation, that flaws which could be missed because they are just outside the inspection zone, would not grow to unacceptable sizes during one fuel cycle of plant operation.

7. Duration of Proposed Alternative

The proposed alternative would apply only during the period in which NRC Order EA-03-009 is in effect, or until inspection technology is developed to a state that the examination volume can be extended to full compliance with the Order, or information is received from the NRC regarding nonacceptance of the crack growth formula in MRP-55.

The crack-growth rate formula used in the structural integrity evaluation for DCPP Unit 1 is the same as reported in industry report MRP-55. If the NRC staff finds that the crack-growth formula in industry report MRP-55 is unacceptable, then PG&E will revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs PG&E of an NRC-approved crack-growth formula. If PG&E's revised analysis shows that the crack-growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation request will be rescinded and PG&E will, within 72 hours, submit to the NRC written justification for continued operation. If the revised analysis shows that the crack-growth acceptance criteria are exceeded during the subsequent operating cycle, PG&E will, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack-growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, PG&E will, within 30 days, submit a letter to the NRC confirming that its analysis has been revised.

Figure 13
Hoop Stress Distribution Downhill and Uphill Side
(0° CRDM Penetration Nozzle)

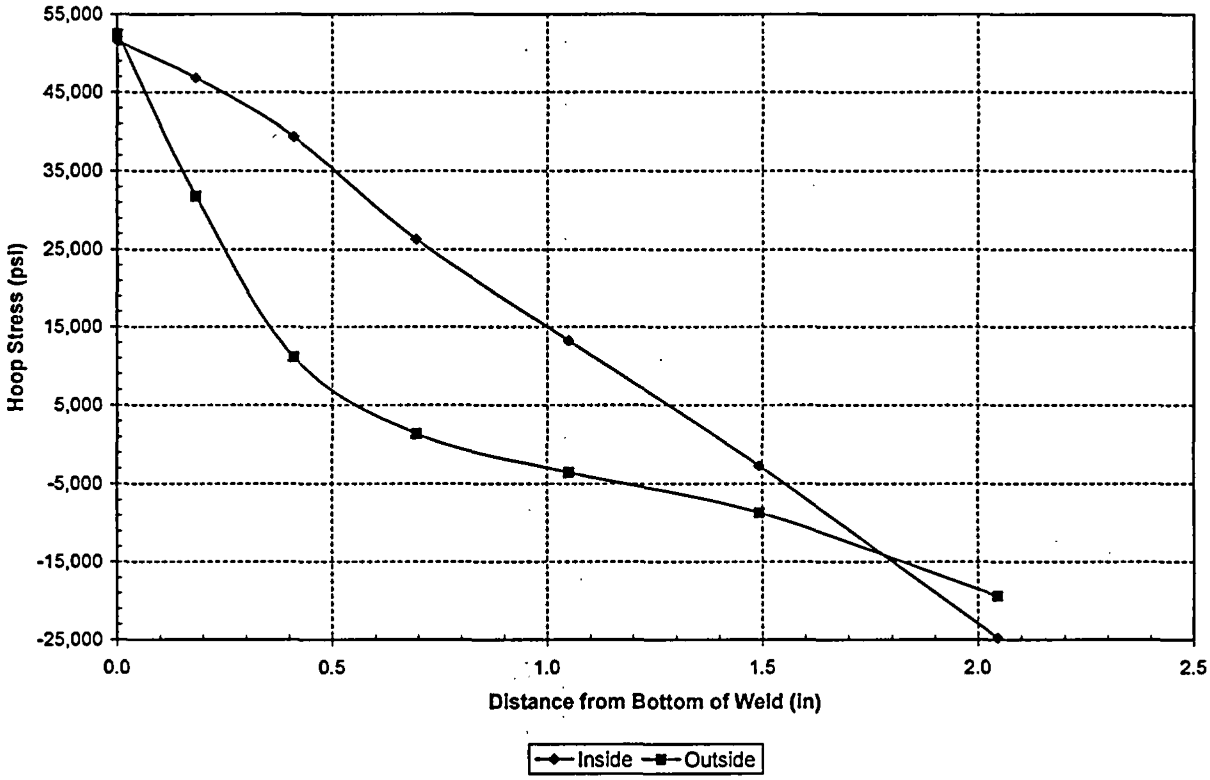


Figure 14
Hoop Stress Distribution Downhill Side
(26.2° CRDM Penetration Nozzle)

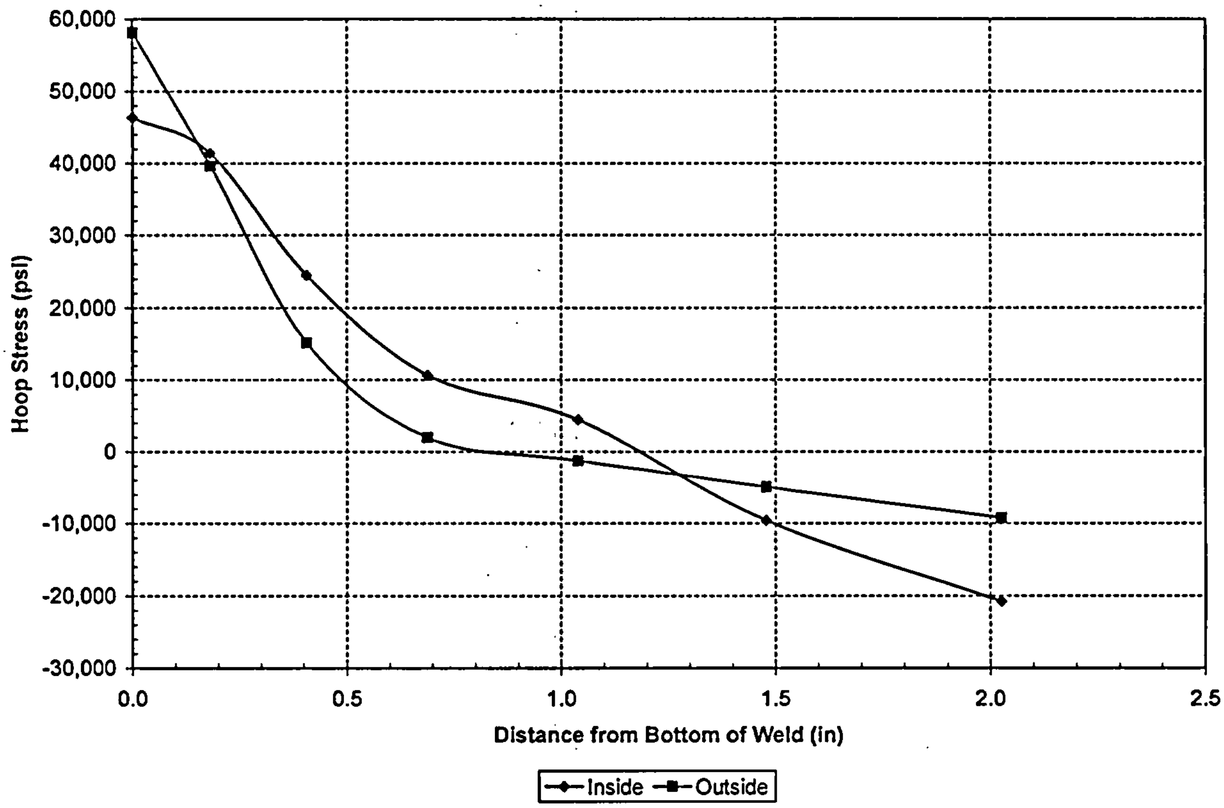


Figure 15
Hoop Stress Distribution Uphill Side
(26.2° CRDM Penetration Nozzle)

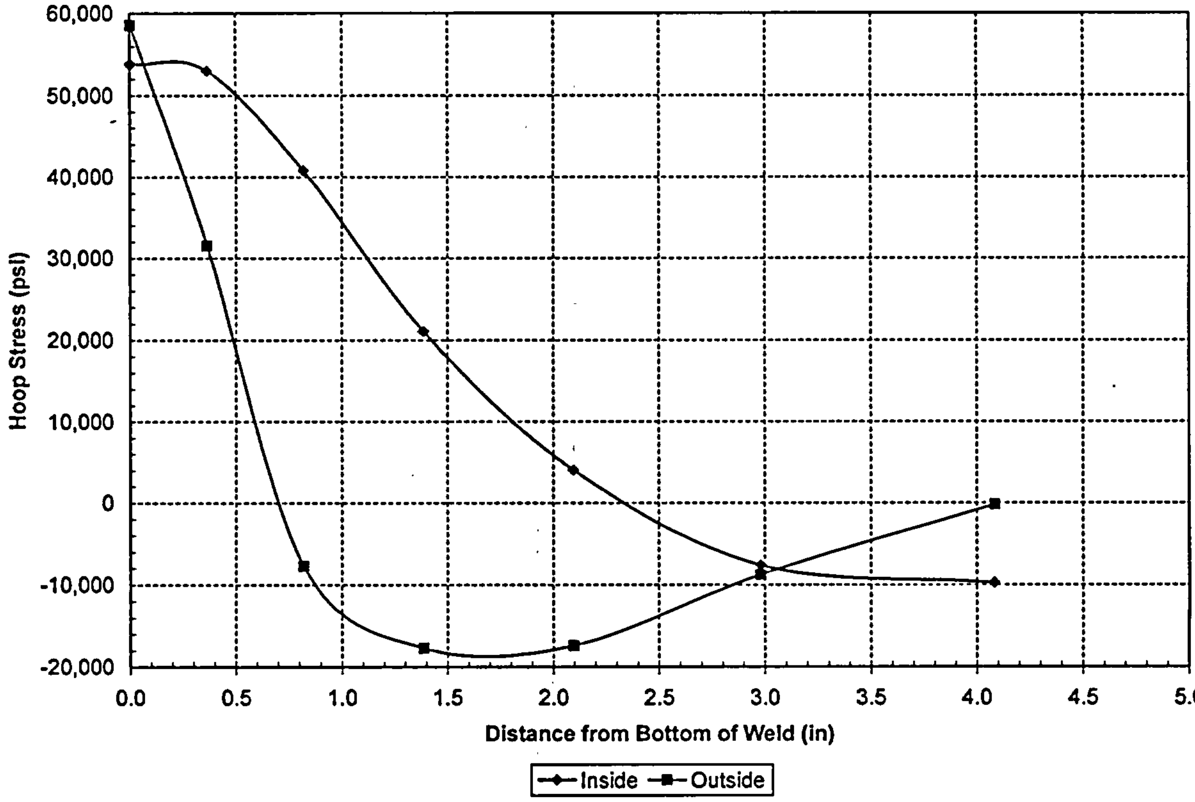


Figure 16
Hoop Stress Distribution Downhill Side
(44.3° CRDM Penetration Nozzle)

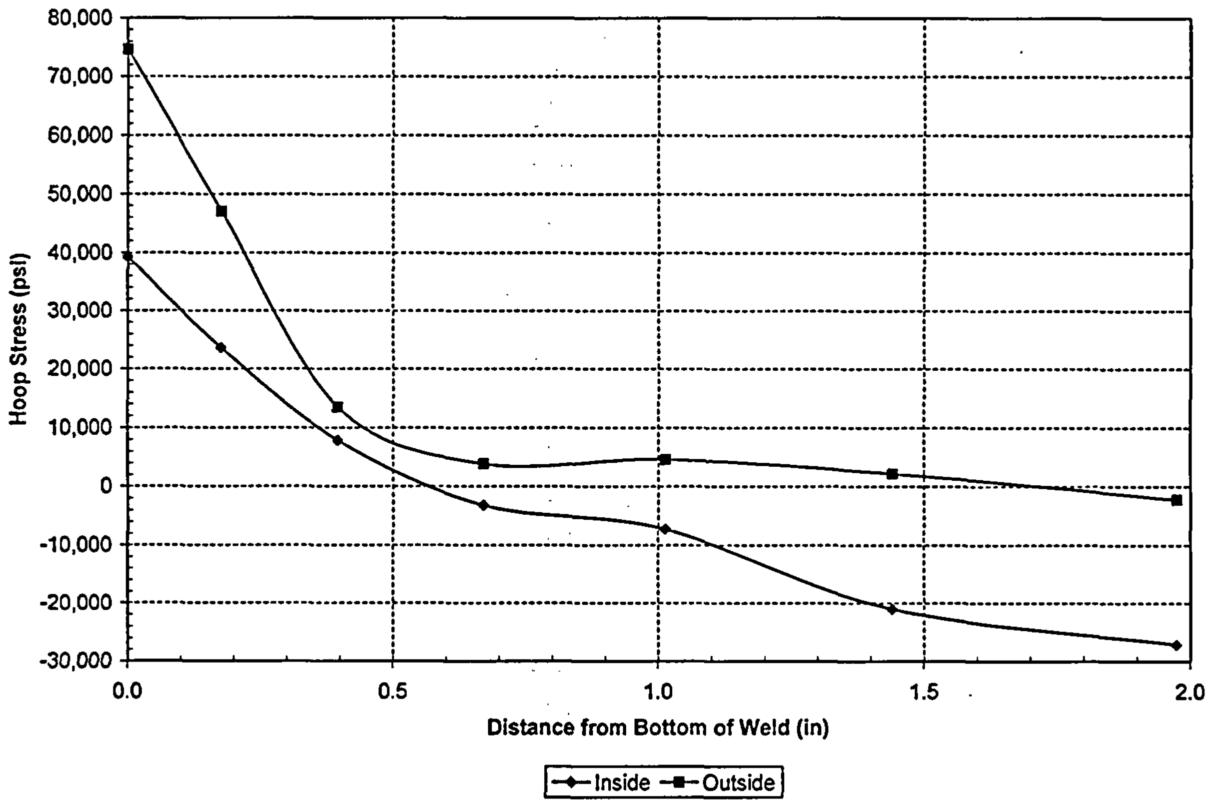


Figure 17
Hoop Stress Distribution Uphill Side
(44.3° CRDM Penetration Nozzle)

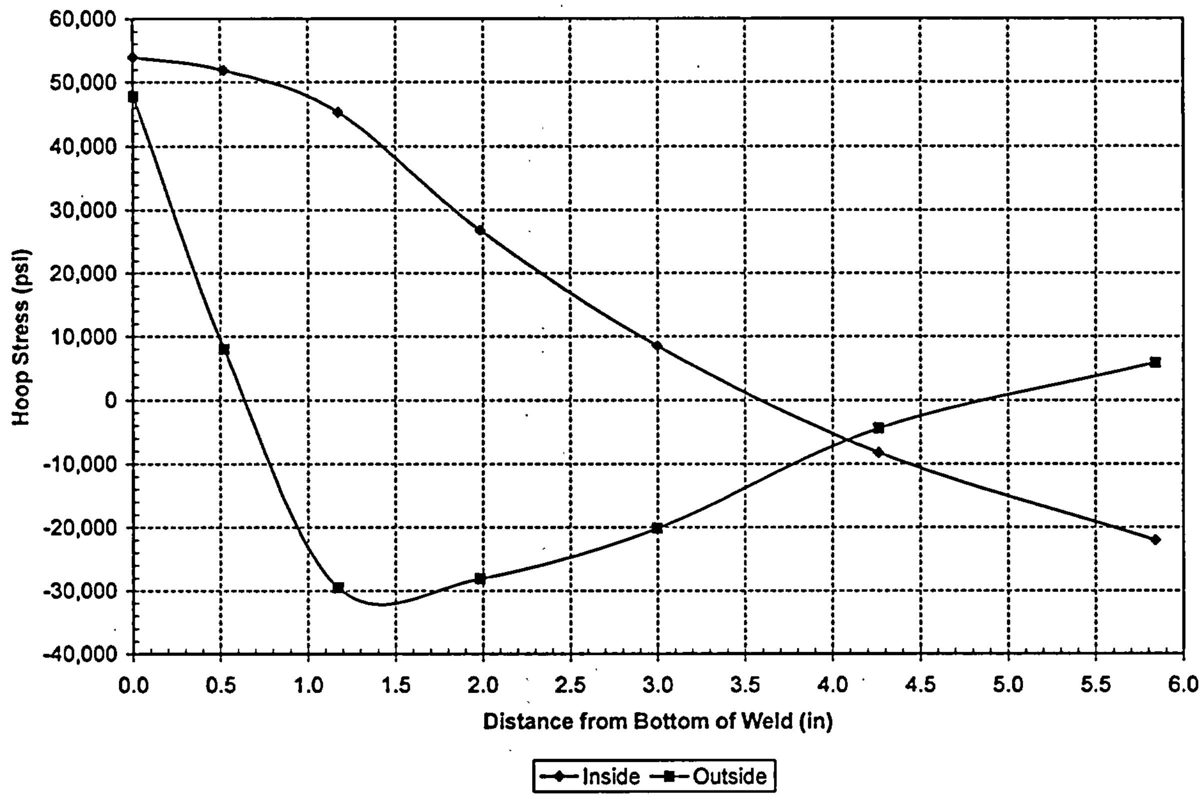


Figure 18
Hoop Stress Distribution Downhill Side
(45.4° CRDM Penetration Nozzle)

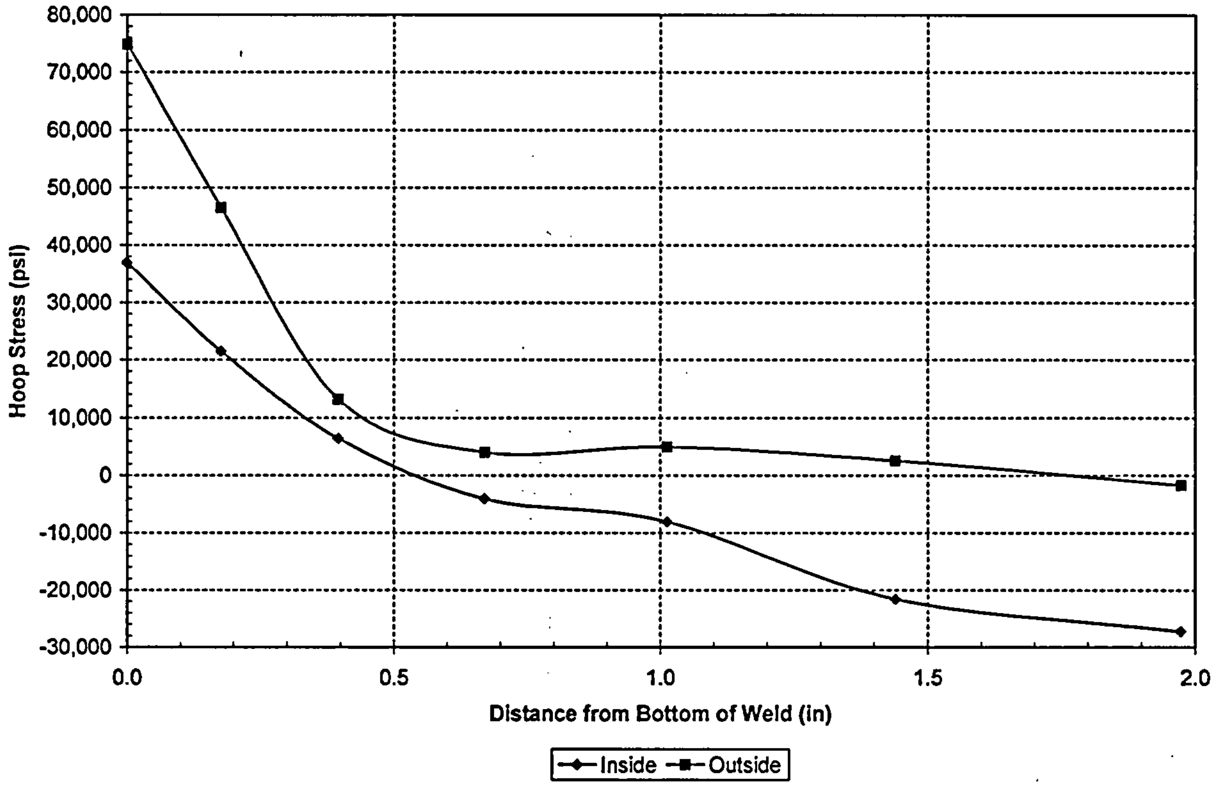


Figure 19
Hoop Stress Distribution Uphill Side
(45.4° CRDM Penetration Nozzle)

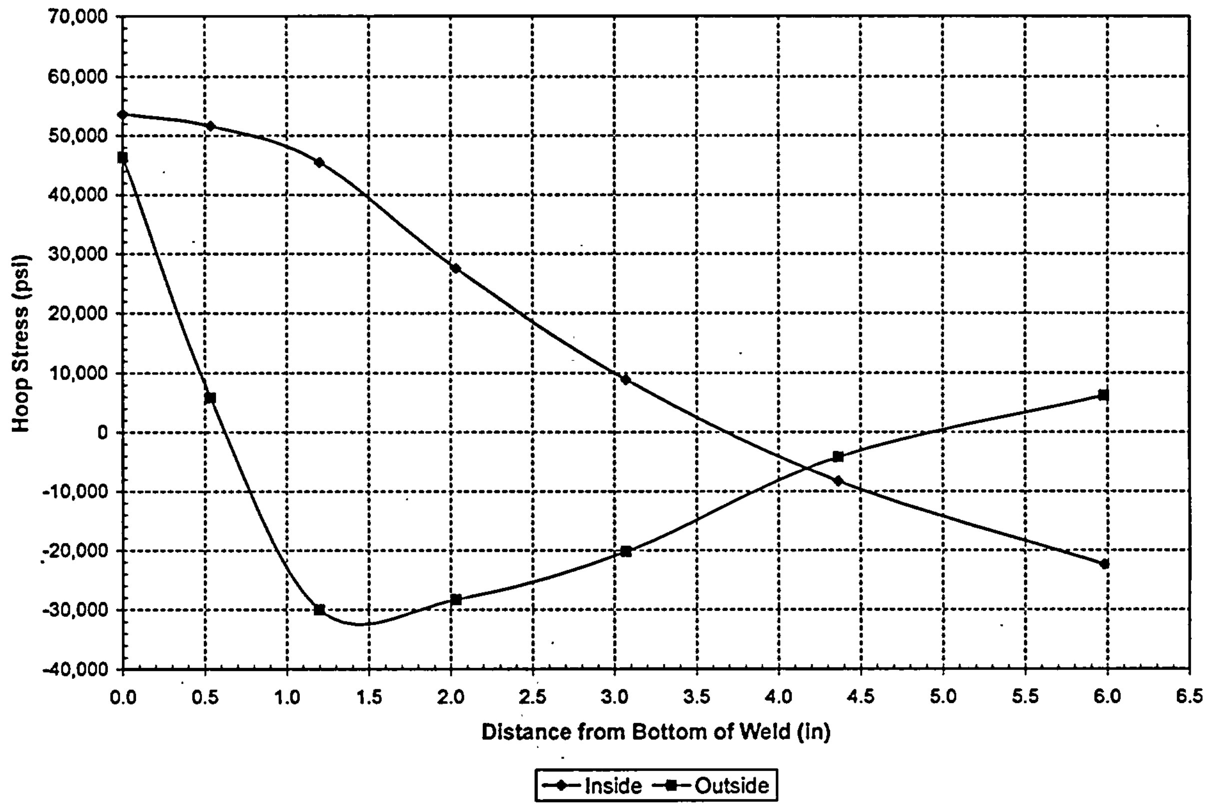


Figure 20
Hoop Stress Distribution Downhill Side
(48.7° CRDM Penetration Nozzle)

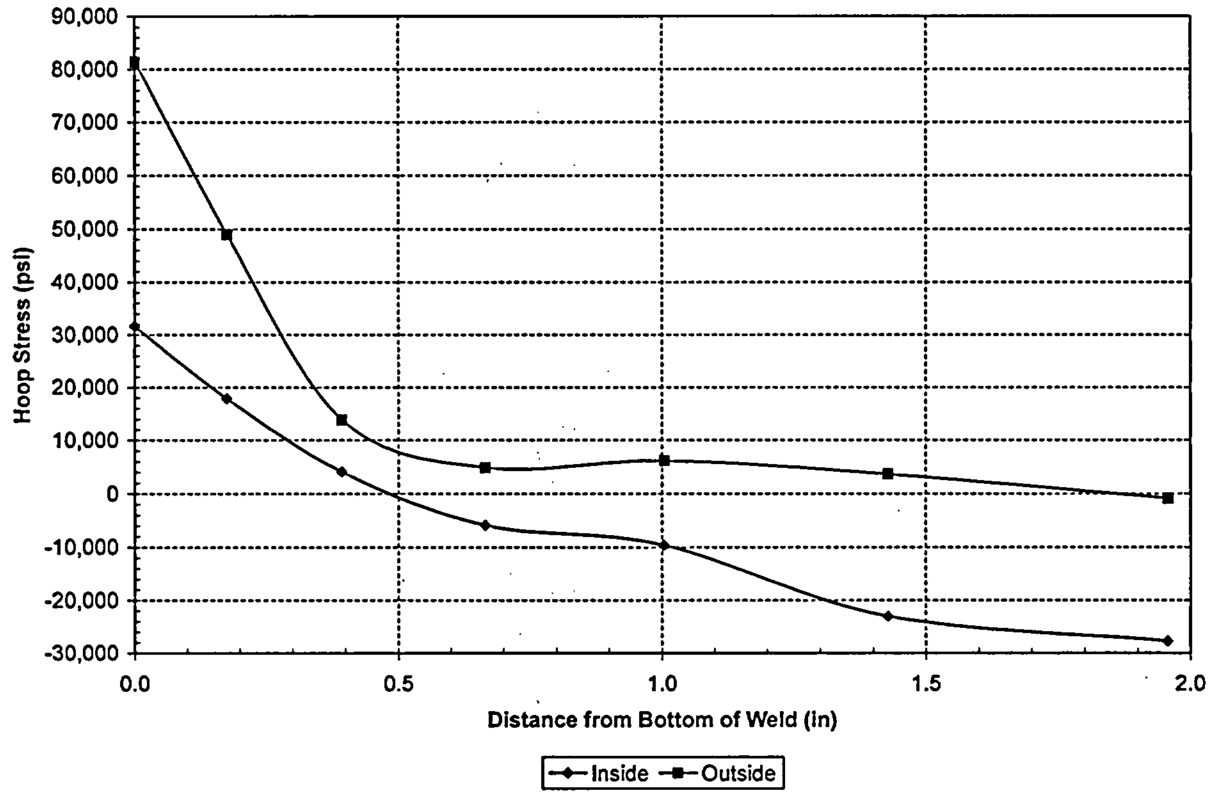


Figure 21
Hoop Stress Distribution Uphill Side
(48.7° CRDM Penetration Nozzle)